Interest Rate Liberalization and Capital Adequacy in Models of Financial Crises

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Abstract

We characterize the effects of interest rate liberalization on OECD banking crises, controlling for the standard macro prudential variables that prevail in the current literature. We use the Fraser Institute's Economic Freedom of the World database. We test for the direct impacts of interest rate liberalization on crisis probabilities and their indirect effects via capital adequacy. Over the period 1980 - 2012, we find that interest rate liberalization has a crises reducing effect, and it appears that the beneficial effects work by strengthening capital buffers. We also show that when controlling for liberalization, capital adequacy and liquidity, the main driver of financial crises is property price growth. Our results are invariant when we control for alternative sensitivity tests for robustness purposes.

JEL classification: C52; E58; G21; G28

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1. Introduction

If we are to learn enduring lessons from the sub-prime crisis we need to know whether it was in some way unique, or whether it shared features in common with earlier banking crises. Recent research focusing on the macro determinants of crises provides evidence that OECD banking instability can be explained by capital adequacy, liquidity, house price growth and current account imbalances (Barrell et al. 2010; 2013). However by definition, these impacts are conditional on the regulatory environment under which banks operate. Over the last three decades the regulatory architecture has experienced major transformations, yet there is little consensus as to how these changes have affected bank risk taking behavior and hence crises probabilities. Given the established links between financial liberalization, crises and efficiency (Barth et al. 2006; Agoraki et al. 2011; and Chortareas et al. 2013; 2016), their interaction with regulatory capital becomes paramount. Regulation of both deposit and lending rates was common in the OECD during the 1980s and 1990s (Edey and Hviding, 1995). For example, Regulation Q in the U.S. enforced interest rate controls for over 50 years on the premise that controlling deposit rate competition would allow banks to earn normal profits without resorting to risky loans and this in turn mitigated the need for regulatory capital.

This paper constitutes the first attempt, to our knowledge, to explicitly characterize the effects of interest rate liberalization on OECD banking crises between 1980 and 2012. Our approach combines both the macro (prudential) and micro strands of the literature on banking stability. To capture these dynamics we utilize the economic freedom index drawn from the Fraser Institute. Although the index characterizes different aspects of financial liberalization, not all of

these are relevant to the OECD.[1] We focus explicitly on interest rate restrictions which changed under formal liberalization programs in many OECD economies during the 1980s and 1990s. We test for the direct impacts of interest rate liberalization on crisis probabilities and their indirect effects via capital adequacy.

Our results show that interest rate liberalization has a crises reducing effect in the OECD. Moreover, the beneficial effects of interest rate liberalization, or the removal of financial repression (see Reinhart, 2012) seems to work by strengthening the effects of capital buffers. In fact, a move towards financial repression after the sub-prime crisis may have marginally increased the probability of future crises. We also show that when we control for liberalization, capital adequacy and liquidity, the main driver of financial crises is property price growth. Other frequently cited factors, such as credit growth and fiscal deficits, do not seem to be significant.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature. Section 3 presents the empirical methodology and the data. Section 4 discusses the empirical results, and Section 5 concludes.

2. Banks and the factors driving bank crises

Banking crises emerge because banks do not have enough liquidity to meet depositors' needs and cannot access the wholesale market, or because loan losses have built up to the point where capital is exhausted. Hence, a relatively simple banking crisis model must include the liquid asset and capital ratios as explanatory variables. In addition, we should control for macro factors

[1] For example, private sector credit controls as defined by the fiscal deficit to gross savings ratios would be of little concern in OECD economies during our sample period. Similarly central government ownership of banks captured by the % of deposits held in government banks would be low in market based OECD banking systems.

that affect the variability of loan losses and deposits. Before discussing the standard controls used in the literature, we note an important omission in these studies: none of them consider the impact of interest rate controls on bank behavior and performance. The pace of financial liberalization increased over the last three decades, particularly during the 1980s and 1990s. For example, the deregulation process in the European Union (1990s) considerably liberalized banks' structural and conduct rules.[2] This was accompanied by a parallel increase in prudential regulation, particularly in relation to a minimum capital adequacy.

The dates of liberalizations in our sample are given in Table 1. Perhaps the most high profile liberalization of deposit rates, the phasing out of Regulation Q in the U.S., began in 1980 and hence falls outside our sample. However, the Nordic countries and the U.K. deregulated their housing market lending in the mid-1980s, removing both lending and deposit rate restrictions. The U.K. liberalization of Building Society restrictions was phased in from late 1984 to early 1986 and hence we record it in 1985. At the same time both Spain and especially Italy began to relax their foreign exchange controls, and these impacted on the regulation of domestic deposit rates in both countries. The dismantling of exchange controls in Italy in late 1990 was also associated with moves to increase regional competition in banking and also to reduce compulsory reserves at the Central Bank, and deposit rates were further liberalized as a result. The granting of independence to the Bank of France in 1994 also coincided with significant increases in bank competition and interest rate deregulation, but these were in part a result of the European Commission's response to the rescue of Credit Lyonnais. In the run up to the financial crisis in 2007-08 some countries, such as Italy attempted to control housing markets with interest rate controls, whilst Norway, by then a major balance of payments surplus country, attempted to control its exchange rate and

[2] See, for example, the banking Directives enacted in the E.U., as part of the Single Market Program.

inflation rate with controls on deposit rates in banks. It was the only country in our sample to do so over this period. Inevitably after the 2007 and 2008 crises there were a number of attempts to tighten controls, and those in the UK and Norway in 2008 and Italy in 2010 are of particular note for our purposes.

It is reasonable to question whether these changes to the regulatory architecture would impact on financial stability and crisis incidence. Since crisis prediction studies using contemporaneous datasets (e.g. Demirguc-Kunt and Detragiache, 1998; 2005) cannot be classed as true early warning systems,[3] Barrell et al. (2010; 2013) use lagged data and focus on the relatively homogeneous OECD banking system. In this context they show that capital adequacy, liquidity, property prices and current account deficits supersede traditional macro variables as crisis determinants. The lag structure of these models ensures true early warning properties and explanatory power within and out-of-sample is high. In this paper, we continue with the Barrell et al. (2013) model but recognize it is contingent on the degree of liberalization in each banking sector. Before turning to our interest rate liberalization variable, we briefly summarize the key explanatory variables in our base line model. The average values of real house price growth, liquidity and leverage across our sample of 14 countries is plotted in figure 1, along with the number of crises in each year between 1980 and 2008.

<Insert Table 1 and Figure 1 about here>

Crises are often the result of poor quality lending. A boom in real estate prices inflates the availability of collateral causing lending to be excessive and credit to be mispriced. Several years

[3] These studies also rely on heterogeneous country sets and so the wide country coverage limits the explanatory data available for inclusion.

after the expansion of lending to borrowers who were not credit worthy, problems normally start to appear. As we can see from Figure 1 the house price booms in the late 1980s and the 2000s were followed by an increase in the number of financial crises. The problems associated with excess lending are exacerbated when real house prices start to fall, as they did around 1990 and also from 2006 in the U.S., with downturns starting later elsewhere. When prices fall from unsustainable levels, this process goes into reverse, sharply tightening credit conditions and overextended borrowers have strong incentives to default. Reinhart and Rogoff (2008) and Barrell et al. (2010) suggest that property price developments can change crisis probabilities. The incidence of crises may be mitigated by adequate levels of capital or by sufficient liquidity. As we can see from Figure 1 liquidity levels fell in the approach to the rash of crises from 1987 onwards, but levels were rebuilt after lessons were learnt. However, from 1999, the new era of international competition in banking led to increasing economizing on liquidity levels, making it harder for the system to deal with crises as they emerged. In addition, the same environment led banks to begin to economize on leverage, and capital buffers began to shrink, raising the risks that a solvency crisis might emerge, as indeed it did in 2008.[4]

Widening current account imbalances have been common forerunners of banking crises in the OECD (Ferretti and Razin, 2000; Edwards, 2002). They may be accompanied by monetary inflows enabling banks to expand credit excessively which inflates asset prices in an unsustainable manner.[5] These trends may be exacerbated by lower real interest rates (Eichengreen and Rose, 2004). This may explain why financial liberalization often precedes current account liberalization

[4] The standard deviation of capital adequacy also rose sharply after 2000, suggesting that some countries economised on capital more than others, and this cross section dimension is clearly important in the determination of the incidence of crises, as we see below. The standard deviation of liquidity also rose sharply around 2004, suggesting that banking systems in some countries were unwisely economising on this safety buffer as well.

[5] In addition foreigners may cease to be willing to finance deficits in domestic currencies if they consider their assets are vulnerable to monetization via inflation, and such a cessation can disrupt asset markets and banks' funding. See Haldane et al. (2007) for an assessment of the impact of such a hypothetical unwinding in the U.S.

so that banks can manage the intermediation of the capital inflows. The existence of a current account deficit also indicates a shortfall of national saving over investment and hence a need for the banking sector to access the potentially volatile international wholesale market.

Other factors that affect loan losses are discussed extensively in Demirguc-Kunt and Detragiache (1998; 2005) and Beck et al. (2006). They include real GDP growth, M2/Foreign exchange reserves, and inflation which capture macroeconomic developments that affect banks' asset quality. Rapid credit growth may indicate lax lending standards and trigger asset booms, while loose monetary policy, given by the short term real interest rate, can have the same effect. Fiscal deficits often affect the risk of crises by overheating the economy and because they reduce the scope available to recapitalise banks, making systemic crises more likely.[6]

Existing research provides strong evidence on the link between financial liberalization and various aspects of bank performance. Economic freedom indexes have been associated with efficiency (Chortareas et al. 2011), bank ratings (Pasiouras et al., 2006), and regulatory structure (Demirguc-Kunt et al., 2004; Barth et al., 2006; Chortareas et al., 2012). A common thread that emerged from these studies is that a high degree of liberalization boosts bank efficiency, reduces corruption in lending, or lowers banking system fragility. However, in these studies the index is introduced within a set of control variables. It is only recently that empirical studies have focused on specific aspects of financial freedom/liberalization and governance effectiveness in banking performance (Chortareas et al., 2013; 2016). Such studies which isolate the different impacts, confirm the importance of factors such as financial liberalization, including interest rate liberalization, on bank efficiency.

[6] Fiscal difficulties were not present prior to the sub-prime crisis but emerged afterwards, as the economy slowed and authorities had to recapitalize banks.

There are several channels by which interest rate controls may affect crisis probabilities. Situations where governments control deposit and/or lending rates (which are captured by our index), will change the scope and riskiness of banks' balance sheets and hence the role of capital. For example, in situations where there are deposit rates ceilings, a rise in the policy interest rates will cause a shortage of bank deposits as funds move elsewhere. As a result of the disintermediation, banks may change their scope of operations and move into securitization in order to increase non-interest income. Therefore, this form of interest rate restrictions is likely to decrease bank efficiency in the manner that Berger et al. (2008) describe. Since systemic risk will increase, the role of regulatory capital becomes more important. Conversely, when deposit rates are deregulated banks can revert to traditional lending, which is subject to normal regulatory capital rules so the marginal benefit of capital is reduced (Hellmann et al., 2000), and crisis probabilities should decline.

Similarly, controls on lending rates may induce banks to find other ways to utilise their funds. To maintain profits banks may increase their off balance sheet positions without concurrently increasing capital, and such disintermediation may increase systemic risk and hence crisis probabilities. When lending rates are market driven, the quantity of loans on banks' balance sheet will increase, but they are more likely to be protected by regulatory capital. Hence, interest rate liberalization and capital are likely to influence crisis probabilities both directly and jointly (Cecchetti and Kohler, 2014). No systematic attempt exists to explicitly measure the impact of interest rate liberalization directly on crisis probabilities and indirectly via capital adequacy and this is the task that we pursue in the following sections.

3. Methodology and data

We utilize the logit model which has been a standard approach for crisis prediction (Demirguc-Kunt and Detragiache, 2005; Davis and Karim, 2008, Barrell et al., 2010; 2013). The logit estimates the probability that a banking crisis will occur in a given country with a vector of explanatory variables (X_{it}). The banking crisis variable (Y_{it}) is a zero-one dummy that takes the value of one at the onset of crisis. The logistic estimator is given by:

$$\Pr ob(Y_{it} = 1) = F(\beta X_{it}) = \frac{e^{\beta' X_{it}}}{1 + e^{\beta' X_{it}}} \quad (1)$$

where, β is the vector of unknown coefficients and $F(\beta' X_{it})$ is the cumulative logistic distribution. The log likelihood function is given by:

$$Log_e\ L = \sum_{i=1}^{n} \sum_{t=1}^{T} \left[(Y_{it} \log_e F(\beta' X_{it})) + (1 - Y_{it}) \log_e (1 - F(\beta' X_{it})) \right] \quad (2)$$

Coefficients show the direction of the effect on crisis probability, although their magnitudes are conditional[7] on X_{it}. We include a constant to allow for the hypothesis that crisis probabilities can be exogenous.

Logit models for banking crises are typically assessed on their predictive success since their value lies in their early warning capabilities. Standard goodness-of-fit measures used to assess

[7] ßi represents the effect of X_i when all other variables are held at their sample mean values.

OLS estimators such as R^2, do not apply to logistic regression (which generate maximum likelihood estimates) and the adjusted variants for logit (such as Mc Fadden's R^2) cannot be interpreted in the same way. In addition, the success of a logit forecast depends on the chosen cut-off for the probability threshold[8]: if a low probability threshold is selected, all crises will be called correctly but the associated false positive call rate will be high. Conversely, high thresholds will result in low levels of crisis identification but correspondingly low false positive call rates. As thresholds rise, we reduce correct crisis calls but we also lose false crisis calls; a good model loses false crisis calls more rapidly than it loses correct crisis calls.

Since a logit model's forecast performance depends on the probability threshold that is selected, its performance can be adjusted by regulators who manipulate the threshold. A policy-maker may rationally choose not to publicly disclose any increases in crisis risk in order to maintain depositor confidence and avoid bank runs. Instead they may choose to show regulatory forbearance since the cost of crises exceeds the cost of bank bailouts (Kane, 1989; Morrison and White, 2013). These policy-makers are then likely to adjust the forecast performance by selecting high thresholds that are optimal for their individual loss functions (Laeven and Valencia, 2013; Calomiris and Jaremski, 2016). This suggests that an unbiased measure of forecast accuracy should be independent of the probability threshold and so when we select between our alternative models, we take this into account.

To assess the informational value of our variables we use a novel measure known as the AUROC or AUC, which is the Area Under the ROC (Receiver Operating Characteristics) Curve. This metric tests the "skill" of binary classifiers and hence can be used to discriminate between competing crisis models. Because probabilistic forecasts (and their corresponding true positive and

[8] Typically for point forecasts, the in-sample crisis frequency is used, see Demirguc-Kunt and Detragiache (1998) and Kamisnky and Reinhart (1999).

true negative rates)[9] are generated against a continuum of thresholds, the AUC is independent of threshold choice. In the terminology of ROC analysis, the two variables of interest are the proportions (P) of true positive call rates (also known as sensitivity of the discriminator, which equals P (crisis forecast | actual crisis occurs) and the false positive call rates (also known as (1-specificity)), which equals P (crisis forecast | no actual crisis occurs).[10] The ROC maps sensitivity as a function of (1-specificity) generating a curve whose integral (AUC) represents the "power" of the early warning model. An AUC of 0.5 is equivalent to a "naïve" estimator that replicates a random coin toss, whilst an AUC above 0.5 implies the model adds value in terms of the ability to call crises correctly with correspondingly lower false negative rates.

Because of data limitations on the availability of consolidated banking sector information on capital, we focus on 14 OECD countries over 1980-2012, namely: Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, Spain, United Kingdom, and the United States.[11] Table 1 list the crises in our sample along with the dates of significant liberalizations that we study. The crises between 1980 and 2003 are taken from the Demirguc-Kunt and Detragiache (2005) database which terminates before the sub-prime crisis. They classify a crisis if the proportion of non-performing loans to total banking system assets exceeds 10%, or the public bailout cost exceeds 2% of GDP, or systemic crisis caused large scale bank nationalization, or extensive bank runs were visible and if not, emergency government intervention was visible. In extending the estimation to the end of our sample we rely on Laeven and Valencia (2010; 2012) who classify crises if there are significant signs of financial distress in the banking

[9] Correspondingly false positive and false negative rates are also generated.
[10] For a recent example of ROC curve usage in the context of crises, see Schularick and Taylor (2012) and Barrell et al. (2013).
[11] Although it would be good to include other countries such as Austria, Ireland, Iceland, Luxembourg, Portugal, Switzerland and Turkey (the rest of the original OECD) as well as Australia and New Zealand who joined before the start of our data set we cannot do so and maintain the core variables used in the paper.

system[12] and significant banking policy intervention[13] measures were taken in response to significant losses in the banking system.

As discussed in Section 2, the variables included in our model are: real GDP growth, inflation, M2/ Foreign Exchange Reserves, real interest rates, fiscal surplus/GDP ratios, the current account/ GDP and real domestic credit growth.[14] We follow Barrell et al. (2010) and include unweighted capital adequacy for banks and bank narrow liquidity as well as real house price growth. The data are from the IMF's International Financial Statistics (IFS) database, with the following exceptions: house prices are from the Bank of International Settlements (BIS) database and unweighted capital adequacy is obtained from the OECD Bank Income and Balance Sheet database (except for the U.K., where data are from the Bank of England). Unweighted capital adequacy is analogous to the commonly used "leverage ratio" since it does not contain Basel risk weights. We use narrow liquidity derived from IFS rather than the broad measure provided in the OECD Bank Income and Balance Sheet database because some elements of broad liquidity, such as short term bonds and corporate bills, could not be liquidated during the sub-prime crisis.[15]

Data on financial liberalization are collected from the by the Fraser Institute (2012) database.[16] The *Fraser's Economic Freedom of the World Index* is the only comprehensive

[12] As indicated by significant bank runs, losses in the banking system, and bank liquidations.
[13] Policy intervention is considered to be significant if at least three out of the following six measures hold: i) extensive liquidity support (5% of deposits and liabilities to non-residents); ii) bank restructuring costs (at least 3% of GDP); iii) significant bank nationalizations; iv) significant guarantees put in place; v) significant asset purchases (at least 5% of GDP), and vi) deposit freezes and bank holidays.
[14] We do not include certain Demirguc-Kunt and Detragiache (1998; 2005) variables because they are irrelevant to OECD countries. For example, GDP per capita is broadly comparable across OECD countries, while virtually all OECD countries have some form of deposit insurance scheme. Variations in the level of credit/GDP (as opposed to credit growth) may reflect the differing nature of the financial system in OECD countries (i.e. bank versus market dominated) rather than the risk of crisis, and we exclude this variable as well.
[15] Narrow liquidity is defined as a sum of banks' claims on the general government and the central bank, while total assets comprise foreign assets, claims on the general government, central bank and private sector.
[16] There exist two major attempts to measure economic freedom producing the corresponding indexes, namely the Economic Freedom of the World Annual Reports produced by the Fraser Institute and the Index of Economic Freedom created by the Heritage Foundation and the Wall Street Journal. Given that the data provided by the Heritage foundation are limited in the time dimension, in this paper we focus on the Fraser's Economic Freedom database.

economic freedom database that presents the rating for a long time dimension. In particular, we explicitly focus on the interest rate liberalization component counterparts of the economic freedom index, which captures government controls aiming at setting lending and deposit rates of banks. This variable ranges from 0 (i.e. interest rates fully set by the government) to 10 (fully liberalized). Countries in which interest rates are determined by the market, monetary policy is stable and real deposit and lending rates are positive, receive higher ratings. We discuss the interest rate liberalization variable and provide detailed definitions on the variables used in our empirical analysis in Appendix B (Tables B.1 and B.2).

4. Results

Our testing strategy involves the estimation of a baseline model (without the effect of interest rate liberalization) and assessing its information content. The model is then re-estimated with the interest rate liberalization effects and changes to the estimates and information content are noted. Finally, we test for the interaction of interest rate liberalization and capital since these may both act as substitutable macroprudential tools (Hellmann, et al., 2000; Cecchetti and Kohler, 2014).

4.1. The baseline vs. interest rate liberalization models

A priori we do not assume the dominance of any explanatory variables, since each contributes to a separate hypothesis on the causes of crises. We rely on nested testing of a logit model using a general to specific approach to obtain parsimony. Unlike Demirguc-Kunt and

Detragiache (2005), all variables are lagged at least one period to provide a true early warning model. We follow Barrell et al. (2010) and lag house prices by three years while AIC tests suggest that for other variables the appropriate lag length should be set at one. In all our experiments the AUC is used as a choice criterion because standard goodness-of-fit measures (such as R^2) used in OLS do not have analogous interpretations with logistic regressions. In addition, the AUC criterion ensures our model selection is not biased by any particular probability threshold. Based on this approach, we find more parsimonious models have similar information content to general ones.[17] This suggests that many of the structural variables we include do not enhance our early warning system for crises. Below we discuss the different parsimonious specifications that we obtain (results for the non-significant variables are presented in Appendix A).

<Insert Table 2 about here>

Table 2 presents the parsimonious form of the results for our baseline model from Barrell et al. (2013) versus those from the model that contains the effects of interest rate liberalization. As we can see in Appendix A (Table A.1), most of the macroeconomic control variables (including GDP growth, credit growth and real interest rates) do not contain information and are not significant crisis predictors. However, real house price growth and bank narrow liquidity/assets are significant in all specifications.

The interesting result concerns the elimination of capital once interest rate liberalization is introduced and the information content search (AUC) is repeated. Whilst both capital and interest rate liberalization have a negative coefficient and therefore independently reduce the likelihood of

[17] Although the AUCs are similar, the differential impacts of the explanatory variables in each model are not the same. These should be evaluated using the marginal contributions which we discuss in Section 4.3.

crisis, the contrast between models 1 and 3 seems to confirm the substitutability of interest rate liberalization and capital. This result appears to support the view that removal of deposit and lending rate controls allows banks to reduce their risky off balance sheet positions and thus the importance of regulatory capital is reduced.

Past episodes of financial liberalization in our sample are also captured by model 3, which suggests that when these countries adopted interest rate liberalization, the current account no longer became a significant determinant of crises. The intuition behind these results is explained in Brooks and Queisser (1999) who discuss the ordering of liberalization reforms in the financial and external sectors that were adopted by most developed countries in our sample period. The work of Edwards (1984); McKinnon (1982, 1991) and Stiglitz (1998) led to a consensus that financial liberalization should precede current account liberalization so that the subsequent capital inflows could be efficiently intermediated by the banking system. This sequencing suggests that interest rate liberalization would create the initial impact on banking system risk in our sample and that the current account effect would be secondary. This may explain why the current account is much more significant in previous specifications (Barrell et al., 2013) where interest rate liberalization is not included.

That interest rate liberalization effectively substitutes for the role of capital does not mean that capital contains no informational value. Indeed, a comparison of the area under the curves between the baseline model (including capital) and model 3 shows that the elimination of capital reduces the AUC (from 0.785 to 0.774). In other words, interest rate liberalization alone may not be able to explain all crises because some of these independently arise from a lack of capital. Therefore, although model 3 does capture the independent effect of interest rate liberalization its

informational value is reduced because it cannot capture the direct crisis reducing effects of capital. This is confirmed by the AUC of model 2 which is identical to the AUC of the baseline model.

As it is clear that interest rate liberalization and capital adequacy have related effects on crisis probabilities, it is reasonable to test their interaction. We do this by including interest rate liberalization and capital as standalone variables alongside a variable that tests their interaction and other macroeconomic controls. This generalized interaction model is detailed in the Appendix A (Table A.2). We find capital and interest rate liberalization are not significant as separate independent variables, although capital adequacy does enter the model (no. 8) that maximizes the AUC. Most of our macroeconomic controls are also not significant, and as we can see from the appendix, the AUC is improved by their omission. This suggests that focusing factors such as GDP growth, budget balances and real interest rates makes us, at least in the OECD, less able to discriminate between periods when there will be crises and when there will not be. When we eliminate these insignificant variables to create a parsimonious model, we find that the interaction between interest rate liberalization and capital has a negative and significant impact on crises probabilities, suggesting that interest rate liberalization strengthens the defensive role of a given level of capital. Table 3 compares the estimates for the baseline model (without the interaction) and the model which interacts capital with interest rate liberalization.[18]

<Insert Table 3 about here>

[18] The transmission of interest rate liberalization to a reduction in financial instability occurs via a change in the scope of banking activity so that for a given level of capital, their balance sheet position improves, increasing the marginal benefit of capital. This transmission differs from direct regulatory changes to capital adequacy, where for a given portfolio of a bank lending, capital requirements are raised. For example, the switch from Basel I to Basel II did not restrict the scope of bank lending but required commensurate increases in the quality of capital. This may explain why when we test the interaction between a dummy which captures the adoption of Basel II with capital, we find that the coefficient is negative but insignificant.

The interaction effect clearly increases the predictive power of the early warning system as can be seen by the AUC which increases from 0.785 to 0.792. In terms of our selection criteria we would therefore choose the interaction model as the preferred explanation of OECD banking crises. In the next sections we evaluate the model performance and subject it to various robustness tests.

4.2. In-sample and forecast performance

We evaluate the forecast performance of our preferred interaction model against the baseline version using the in- and out- of sample crisis call rates. Between 1980 and 2008 our in-sample frequency of crises is 0.063. A predicted probability in excess of this is classed as a 'correct call'.[19] On this basis our interaction model called 11 out of 12 crises (91% success rate) in the sub-prime period, with only one missed crisis in Germany. The crises that were correctly identified are Belgium, Netherlands, Italy, Denmark, Sweden, France, Spain, U.K. and U.S. (the last two countries being classed as having two distinct crises). One can argue that the German crisis did not follow from domestic problems, but rather from excessive exposure to U.S. sourced Mortgage Backed Securities. There were only two false calls, which occurred in Canada, where the combination of an oligopolistic banking system, a well-organized central bank and close knowledge of U.S. mortgage markets resulted in lower systemic risk.

Out of sample performance is perhaps more revealing. Laeven and Valencia (2012) suggest that there were three systemic crises after 2008: Germany (2009), Denmark (2009) and Spain (2011). Our model fails to call Germany but can detect the other two crises. The true crisis

[19] Assuming it occurred either in the crisis year or the preceding year.

call rate is 67% whilst the false crisis call rate[20] is just under 40%, but these are once again heavily concentrated in Canada and to a lesser extent U.K. and France. Given the good forecasting performance of our preferred model we next turn to examine the marginal contributions of the explanatory variables to crises in the OECD.

4.3. The relative importance of factors contributing to crisis incidence

It is useful to examine the relative contributions of factors that have affected the incidence of crises in our sample period. This involves calculating the marginal effects of each variable across time period and country and using these to assess the changes in probabilities indicated by the model. The marginal effects of logit models cannot be interpreted in the same manner as linear regression models since:

$$\frac{d\Lambda\left[\beta' x_{i,j,t}\right]}{d(\beta' x_{i,j,t})} = \frac{e^{\beta' x_{i,j,t}}}{(1+e^{\beta' x_{i,j,t}})^2} = \Lambda(\beta' x_{i,j,t})(1-\Lambda(\beta' x_{i,j,t})), \quad (3)$$

where, $\Lambda(\cdot)$ is the logistic cumulative distribution function, β is the vector of coefficients and $x_{i,j,t}$ is the vector of our explanatory variables (see Greene, 2012). Hence, in logistic regressions, marginals are not single estimates but depend on the value of $x_{i,j,t}$ and as such cannot be discerned directly from the coefficients. For each variable (i) in each country (j) and each time period (t)

[20] There were 22 false crisis calls, with the largest number being in Canada (4), in the forecast period.

we calculate the proportional contribution ($Contrib_{i,j,t}$) of the factor $x_{i,j,t}$ to the change in predicted probability by computing:

$$Contrib_{i,j,t} = \frac{d\Lambda\left[\beta' x_{i,j,t}\right]}{d(\beta' x_{i,j,t})} \times (x_{i,j,t} - x_{i,j,t-1}) \quad (4)$$

In table 4 the average contributions across countries are reported for each decade. The most striking result is that house price appreciation in the OECD was the largest contributor to systemic risk during the 1980s and 2000s. During the 1980s increases in risky mortgages were partially offset by interest rate liberalization and bank liquidity but inadequacies in capital elevated crisis risk.

<Insert Table 4 about here>

In the 1990s capital ratios were the major factor driving changes in crisis incidence and regulation had no overall effect. During the 1980s when countries embarked on liberalization programs, capital was a less important crisis determinant whereas by the 1990s when much of the liberalization was complete, capital became the principle cause of crisis. In the 2000s the decline in liquidity contributed about 40 per cent to the change in probabilities whilst house price growth was also a major factor. The reversal of liberalization around the sub-prime crisis in some OECD

countries means that this variable had a minor impact on the probability of crises, raising it slightly.[21]

4.4. Robustness checks

In this section, we present a variety of additional estimates to examine the robustness of our results. These tests deal with the sensitivity of our results to: (i) dropping the systemic crises countries individually, (ii) relaxing the assumption of the one year lag structure, (iii) estimating the results up to the 2006 (to exclude the sub-prime crisis), and (iv) testing the importance of concentration. In particular, we re-estimate the logit equation from Tables 2 and 3 using a number of alternative procedures. Following Barrell et al. (2010), we allow for the possibility that our results are driven by extreme volatility in our independent variables that is caused by systemic crises. By removing the major systemic crises from our sample and re-estimating the model we can confirm its robustness even in the absence of systemic events. This results in the deletion of the U.K., the U.S., Japan, Norway, Finland and Sweden individually and the U.S. and Japan together to accommodate the high degree of contagion between their banking systems. The estimations in Table 5 show that our results remain virtually the same as those discussed in Section 4.1.

Secondly, to confirm whether our results rest on the assumption of the one year lag structure, we allow for the possibility that our independent variables started influencing crises probabilities two years prior to their onset. As shown in Table 6 this amendment does not change

[21] See Reinhart (2012) for a discussion on the increases in financial repression that have occurred in several OECD countries in the post sub-prime crisis (2008-2012) era. These repressive measures have effectively imposed interest rate ceilings on bank deposits.

the results to any great extent. The global magnitude of the sub-prime crisis is well known and it could be argued that our estimation parameters arise from the inclusion of this episode in our sample. To check that our result can be applied to the OECD from the 1980s onwards we terminate our sample at 2006. Table 7 shows that our results remain robust indicating interest rate liberalization should be an important policy issue.

Finally, we check whether our results are robust to the degree of bank concentration. Beck et al. (2006) find that crises are less likely in economies with more concentrated banking systems (the "concentration-stability" hypothesis) because enhanced market power increases supernormal profits and higher charter values reduce the incentive to take risk. Interestingly, when we test for the role of concentration using the Beck et al. (2006) data, we also find a negative but insignificant coefficient in the baseline model and a positive but still insignificant coefficient in the model that contains the interaction term. One explanation is that the sample period of Beck et al. (2006) does not capture several episodes of liberalization in our OECD sample. The results are reported in Appendix C (Tables C.1 and C.2).

<Insert Tables 5-7 about here>

5. Conclusion

We show that over the last 35 years interest rate liberalization had a crisis reducing effect in the OECD alongside capital, liquidity and current account surpluses. The main forms of liberalizations have been reductions on constraints of activities and products, in the presence of less rigorous capital and liquidity requirements. On the other hand, property price growth

consistently raised crisis risk. Our results are robust to a variety of alternative estimation checks, including country eliminations and exclusion of the sub-prime episode.

It is often thought that liberalization is associated with an increased incidence of financial crises. Our results show this is not always the case; financial liberalization cannot be related to systemic risk in a generic way. Liberalization encompasses many different channels by which bank behavior may be affected, ranging from general law and order to particular restrictions on banking activity. When we test interest rate liberalization specifically, we find it has a crisis reducing effect due to its interaction with capital adequacy. The removal of interest rate controls appears to increase the marginal benefit of regulatory capital, in part by inducing banks to reduce their risky off balance sheet positions, which reduces systemic risk.

These results are of policy interest, especially in the aftermath of the sub-prime crisis where regulators have leant toward increased financial repression in order to limit the way in which banks intermediate funds. When house prices continue to rise, increased restrictions on bank activity through interest rate controls may be counterproductive. From a policy perspective, regulators should monitor future house price dynamics which they may need to mitigate. In addition, the promotion of market based interest rates may yield benefits in terms of financial stability.

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Table 1

List of banking crises and finacial liberalization episodes.

Belgium	Canada	Denmark	Finland	France	Germany	Italy	Japan	Netherlands	Norway	Spain	Sweden	U.K.	U.S.	Total
0	1983	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	1984	0	1
0	0	1987	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	1988	1
0	0	0	0	0	0	1990	0	0	1990	0	0	0	0	2
0	0	0	1991	0	0	0	1991	0	0	0	1991	1991	0	4
0	0	0	0	1994	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	1995	0	1
0	0	0	0	0	0	0	0	0	0	0	0	2007	2007	2
2008	0	2008	0	2008	2008	0	0	2008	0	2008	2008	2008	2008	9
0	0	2009	0	0	2009	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	0	0	2011	0	0	0	1

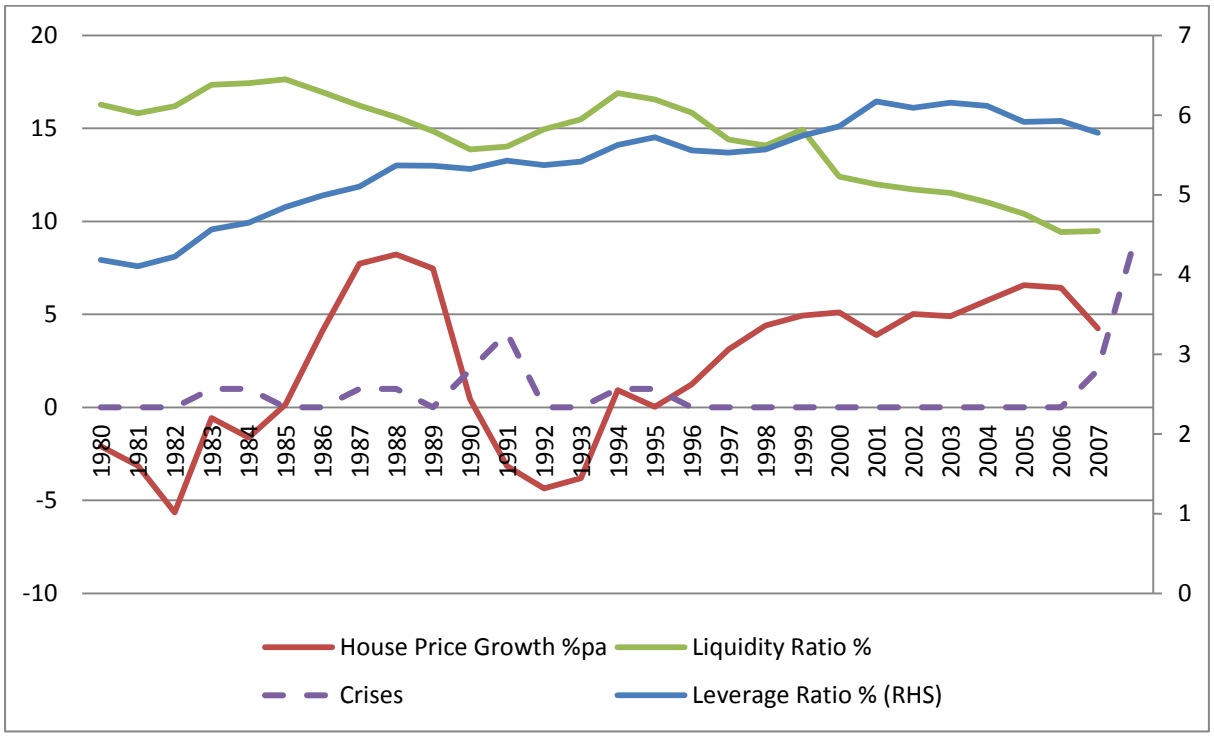
Note: Crises dates are from Demirguc-Kunt and Detragiache (2005) and from Laeven and Valencia (2010; 2012) databases.

Liberalization dates .

Belgium	Canada	Denmark	Finland	France	Germany	Italy	Japan	Netherlands	Norway	Spain	Sweden	U.K.	U.S.
			1985	1995		1985			1985	1985	1985	1985	
						1990			*2000*				
									2001	*2002*			
									2004	2005			
						2006			2007				
									2008				
									2009			*2009*	
	2010					*2010*							

Note: Dates on financial liberalization are collected from the by the Fraser Institute (2012) database. Dates in italics indicate a move towards financial repression and thus an increase in interest rate controls.

Figure 1
Factors associated with Crises since 1980.



Note: The average values are calculated for the in-sample period (1980 and 2008).

Table 2
The effects of interest rate liberalization on crises probabilities.

Dependent Variable: Crisis Onset	Regression Stages		
	Baseline Model	Interest Rate Liberalization	
		With Capital	Parsimonious
	(1)	(2)	(3)
Interest Rate Liberalization (-1)	-	-0.148 (0.130)	-0.226 (0.000)
Liquidity Ratio (-1)	-0.131 (0.000)	-0.099 (0.007)	-0.093 (0.008)
Δ Real House Price (-3)	0.096 (0.004)	0.105 (0.002)	0.116 (0.000)
Current Account Balance (% of GDP) (-1)	-0.156 (0.018)	-0.121 (0.074)	-
Capital Adequacy Ratio (-1)	-0.288 (0.000)	-0.106 (0.450)	-
AUC	0.785	0.785	0.774

Note: the reported coefficients are the outcome of the logit estimator.
Estimated period: 1980-2008. Coefficient (p-values).

Table 3
Interaction between interest rate liberalization and capital adequacy.

Dependent Variable: Crisis Onset	Regression Stages	
	Baseline Model	Interaction
Interest Rate Liberalization*Capital Adequacy Ratio (-1)	-	-0.031 (0.000)
Liquidity Ratio (-1)	-0.131 (0.000)	-0.13 (0.000)
Δ Real House Price (-3)	0.096 (0.004)	0.101 (0.003)
Current Account Balance (% of GDP) (-1)	-0.156 (0.018)	-0.158 (0.018)
Capital Adequacy Ratio (-1)	-0.288 (0.000)	-
AUC	0.785	0.792

Note: the reported coefficients are the outcome of the logit estimator.
Estimated period: 1980-2008. Coefficient (p-values).

Table 4
Relative contributions of variables to crisis probabilities.

	Variables			
Years	Interest rate liberalization	Capital	Liquidity	Real house prices
1980s	-0.01	0.1	-0.05	0.89
1990s	0	1.18	0.02	-0.27
2000s	0.04	-0.03	0.38	0.55

Source: Authors' calculations.

Table 5
Results for country elimination tests.

Final panel (a)	U.K.	U.S.	Japan	U.S. & Japan	Norway	Finland	Sweden
Interest Rate Liberalization	not included	not included	not included	not included	not included	not included	not included
-0.226	-0.196	-0.167	-0.250	-0.189	-0.315	-0.363	-0.225
(0.000)	(0.002)	(0.190)	(0.014)	(0.003)	(0.002)	(0.000)	(0.006)
-0.093	-0.084	-0.088	-0.094	-0.090	-0.098	-0.110	-0.092
(0.008)	(0.024)	(0.013)	(0.007)	(0.011)	(0.005)	(0.002)	(0.009)
0.116	0.114	0.121	0.116	0.121	0.119	0.129	0.116
(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Final panel (b) Interaction Interest Rate Liberalization * Capital Adequacy	U.K. not included	U.S. not included	Japan not included	U.S. & Japan not included	Norway not included	Finland not included	Sweden not include
-0.031	-0.028	-0.024	-0.028	-0.026	-0.026	-0.033	-0.024
(0.000)	(0.002)	(0.005)	(0.021)	(0.003)	(0.023)	(0.001)	(0.015)
-0.130	-0.116	-0.102	-0.125	-0.115	-0.120	-0.140	-0.111
(0.000)	(0.006)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
0.101	0.101	0.117	0.102	0.111	0.100	0.101	0.104
(0.003)	(0.003)	(0.001)	(0.003)	(0.002)	(0.003)	(0.004)	(0.002)
-0.158	-0.147	-0.123	-0.157	-0.146	-0.155	-0.165	-0.154
(0.018)	(0.037)	(0.078)	(0.019)	(0.033)	(0.017)	(0.017)	(0.020)

Note: the reported coefficients are the outcome of the logit estimator. Estimated period: 1980-2008. Coefficient (p-values).

Table 6
Results for the second lag.

	Interest Rate Liberalization * Capital Adequacy	Interest Rate Liberalization
Interest Rate Liberalization (-2)	-	-0.228
	-	(0.000)
Liquidity Ratio (-2)	-0.126	-0.088
	(0.000)	(0.008)
D Real House (-3)	0.102	0.117
	(0.002)	(0.000)
Interest Rate Liberalization*Capital Adequacy Ratio (-2)	-0.031	-
	(0.000)	-
	-0.185	-
Current Account Balance (% of GDP) (-2)	(0.012)	-

Note: the reported coefficients are the outcome of the logit estimator.
Estimated period: 1980-2008. Coefficient (p-values).

Table 7
Results excluding the sub-prime crisis.

	Interest Rate Liberalization * Capital Adequacy	Interest Rate Liberalization
Interest Rate Liberalization (-1)	-	-0.330
	-	(0.000)
Liquidity Ratio (-1)	-0.084	-0.053
	(0.018)	(0.1464)
D Real House (-3)	0.097	0.110
	(0.019)	(0.003)
Interest Rate Liberalization*Capital Adequacy Ratio (-1)	-0.055	-
	(0.000)	-
	-0.350	-
Current Account Balance (% of GDP) (-1)	(0.010)	-

Note: the reported coefficients are the outcome of the logit estimator.
Estimated period: 1980-2006. Coefficient (p-values).

Appendix A

A.1 The effects of interest rate liberalization on crises probabilities.

Dependent Variable: Crisis Onset	Regression Stage									
	1	2	3	4	5	6	7	8	9	10
Interest Rate Liberalization (-1)	-0.287 (0.196)	-0.287 (0.194)	-0.283 (0.199)	-0.245 (0.223)	-0.268 (0.148)	-0.267 (0.149)	-0.266 (0.150)	-0.148 (0.130)	-0.212 (0.000)	-0.226 (0.000)
Liquidity Ratio (-1)	-0.112 (0.011)	-0.112 (0.011)	-0.114 (0.009)	-0.118 (0.005)	-0.117 (0.005)	-0.107 (0.005)	-0.106 (0.005)	-0.099 (0.007)	-0.096 (0.007)	-0.093 (0.008)
D Real House Price (-3)	0.117 (0.002)	0.117 (0.002)	0.117 (0.002)	0.115 (0.002)	0.116 (0.001)	0.109 (0.001)	0.107 (0.002)	0.105 (0.002)	0.103 (0.002)	0.116 (0.000)
Current Account Balance (% of GDP) (-1)	-0.104 (0.219)	-0.104 (0.218)	-0.108 (0.195)	-0.101 (0.213)	-0.108 (0.157)	-0.126 (0.063)	-0.124 (0.067)	-0.121 (0.074)	-0.103 (0.087)	
Capital Adequacy Ratio (-1)	-0.102 (0.525)	-0.103 (0.503)	-0.106 (0.49)	-0.1 (0.508)	-0.107 (0.473)	-0.129 (0.366)	-0.123 (0.389)	-0.106 (0.450)		
Constant	1.006 (0.683)	1.008 (0.682)	1.077 (0.657)	0.647 (0.771)	1.016 (0.573)	1.194 (0.502)	1.302 (0.461)			
ΔGDP (-1)	0.077 (0.573)	0.077 (0.573)	0.078 (0.571)	0.089 (0.513)	0.083 (0.54)	0.06 (0.638)				
Budget Balance (% of GDP) (-1)	-0.034 (0.692)	-0.034 (0.692)	-0.038 (0.652)	-0.045 (0.574)	-0.045 (0.578)					
Real Interest Rate (-1)	0.049 (0.596)	0.049 (0.596)	0.046 (0.614)	0.019 (0.777)						
Inflation (-1)	-0.072 (0.671)	-0.072 (0.669)	-0.072 (0.668)							
M2 Money/ Forex Reserves (-1)	0 (0.847)	0 (0.846)								
Δ Domestic Credit (-1)	0 (0.991)									
AUC	0.805	0.805	0.806	0.807	0.797	0.800	0.803	0.797	0.794	0.774

Note: the reported coefficients are the outcome of the logit estimator. Estimated period: 1980-2008. Coefficient (p-values).

A.2 The effects of Interest Rate Liberalization*Capital Adequacy on crises probabilities.

Dependent Variable: Crisis Onset	Regression Stage									
	1	2	3	4	5	6	7	8	9	10
Interest Rate Liberalization*Capital Adequacy Ratio (-1)	-0.125 (0.418)	-0.123 (0.418)	-0.124 (0.415)	-0.074 (0.13)	-0.067 (0.143)	-0.071 (0.092)	-0.069 (0.097)	-0.069 (0.097)	-0.021 (0.12)	-0.031 (0.000)
Liquidity Ratio (-1)	-0.113 (0.011)	-0.113 (0.011)	-0.115 (0.009)	-0.113 (0.009)	-0.117 (0.005)	-0.116 (0.006)	-0.106 (0.006)	-0.104 (0.006)	-0.108 (0.007)	-0.13 (0.000)
D Real House Price (-3)	0.121 (0.001)	0.121 (0.001)	0.12 (0.001)	0.12 (0.001)	0.118 (0.001)	0.12 (0.001)	0.111 (0.001)	0.11 (0.001)	0.104 (0.002)	0.101 (0.003)
Current Account Balance (% of GDP) (-1)	-0.112 (0.197)	-0.111 (0.198)	-0.115 (0.178)	-0.113 (0.182)	-0.105 (0.199)	-0.111 (0.15)	-0.132 (0.052)	-0.129 (0.056)	-0.14 (0.043)	-0.158 (0.018)
Constant	-4.037 (0.551)	-4.002 (0.552)	-3.953 (0.556)	-1.642 (0.165)	-1.705 (0.146)	-1.58 (0.13)	-1.361 (0.167)	-1.248 (0.191)	-0.771 (0.384)	
Capital Adequacy Ratio (-1)	1.091 (0.46)	1.083 (0.461)	1.089 (0.458)	0.604 (0.234)	0.541 (0.261)	0.575 (0.211)	0.53 (0.237)	0.537 (0.23)		
ΔGDP (-1)	0.081 (0.559)	0.081 (0.559)	0.081 (0.556)	0.078 (0.571)	0.088 (0.518)	0.083 (0.538)	0.058 (0.649)			
Budget Balance (% of GDP) (-1)	-0.043 (0.617)	-0.043 (0.614)	-0.047 (0.579)	-0.042 (0.613)	-0.049 (0.54)	-0.05 (0.54)				
Real Interest Rate (-1)	0.044 (0.637)	0.044 (0.638)	0.041 (0.657)	0.042 (0.645)	0.015 (0.818)					
Inflation (-1)	-0.062 (0.722)	-0.06 (0.725)	-0.062 (0.719)	-0.07 (0.677)						
Interest Rate Liberalization (-1)	0.241 (0.732)	0.235 (0.735)	0.243 (0.727)							
M2 Money/ Forex Reserves (-1)	0.000 (0.81)	0.000 (0.813)								
Δ Domestic Credit (-1)	0.000 (0.948)									
AUC	0.819	0.815	0.814	0.817	0.812	0.810	0.806	0.813	0.796	0.792

Note: the reported coefficients are the outcome of the logit estimator. Estimated period: 1980-2008. Coefficient (p-values).

Appendix B

B.1 Variables description and sources.

Variables	Description	Sources
Interest Rate Liberalization	This variable is constructed using data on credit-market controls and regulations and takes values between 0 and 10. Countries with interest rates determined by the market, stable monetary policy and reasonable real-deposit and lending-rate spreads received higher ratings. When interest rates were determined primarily by market forces as evidenced by reasonable deposit and lending-rate spreads, and when real interest rates were positive, countries were given a rating of 10. A zero rating was assigned when the deposit and lending rates were fixed by the government and real rates were persistently negative by double-digit amounts or hyperinflation had virtually eliminated the credit market.	Economic Freedom of the World. Fraser Institute.
Liquidity Ratio	The variable is constructed as the ratio of narrow liquidity over total assets. Narrow liquidity is defines as the sum of banks' claims on general government and the central bank, whereas total assets comprise foreign assets, claims on general government, central bank and private sector.	IMF International Financial Statistics (IFS) database.
Real House Price	This variable is the nominal house price growth that has been adjusted with the GDP deflator.	Bank of International Settlements (BIS) database
Current Account Balance	This variable is measured as the sum of net exports of goods and services, net primary income and net secondary income, as a percentage of GDP.	IMF International Financial Statistics (IFS) database.
Capital Adequacy Ratio	This variable measures the unweighted capital adequacy ratio (leverage) as a ratio of capital and reserves relative to total balance sheet assets.	OECD income statement and balance sheet database. Bank of England (for U.K.).

B.2 Descriptive statistics.

Variables	Mean	Max	Min	St.Dev.
Interest Rate Liberalization	9.6	10.0	4.0	1.2
Liquidity Ratio	14.2	39.7	0.9	8.0
Real House Price	1.8	36.2	-20.3	7.1
Current Account Balance	0.9	16.4	-10.0	3.9
Capital Adequacy Ratio	5.4	11.6	1.1	2.0

Source: Authors' calculations. Sample period: 1980-2010.

Appendix C

C.1 The effects of bank concentation in our baseline model.

Dependent Variable: Crisis Onset	Regression Stage									
	1	2	3	4	5	6	7	8	9	10
Interest Rate Liberalization (-1)	-1.477 (0.037)	-1.461 (0.035)	-1.464 (0.036)	-1.305 (0.022)	-1.223 (0.013)	-1.084 (0.011)	-1.006 (0.012)	-0.908 (0.016)	-0.907 (0.014)	-0.932 (0.012)
Liquidity Ratio (-1)	-0.108 (0.382)	-0.10 (0.356)	-0.085 (0.337)	-1.131 (0.060)	-0.122 (0.050)	-0.113 (0.057)	-0.115 (0.045)	-0.121 (0.028)	-0.101 (0.047)	-0.097 (0.056)
D Real House Price (-3)	0.148 (0.074)	0.144 (0.070)	0.139 (0.067)	0.107 (0.076)	0.098 (0.057)	0.100 (0.053)	0.100 (0.047)	0.100 (0.044)	0.098 (0.046)	0.124 (0.004)
Constant	2.71 (0.709)	2.838 (0.695)	3.300 (0.638)	6.182 (0.275)	4.994 (0.230)	5.028 (0.215)	4.843 (0.216)	5.452 (0.158)	6.078 (0.099)	
Inflation (-1)	0.444 (0.232)	0.440 (0.236)	0.434 (0.244)	0.0505 (0.100)	0.455 (0.083)	0.458 (0.074)	0.386 (0.111)	0.265 (0.200)	0.193 (0.307)	
ΔGDP (-1)	0.000 (0.192)	0.417 (0.181)	0.379 (0.151)	0.321 (0.179)	0.316 (0.181)	0.292 (0.210)	0.297 (0.201)	0.227 (0.254)		
M2 Money/ Forex Reserves (-1)	0.000 (0.211)	0 .000 (0.173)	0.000 (0.146)	0.000 (0.243)	0.000 (0.197)	0.000 (0.241)	0.000 (0.250)			
Δ Domestic Credit (-1)	0.000 (0.223)	0.000 (0.215)	0.000 (0.188)	0.000 (0.265)	0.000 (0.246)	0.000 (0.314)				
Capital Adequacy Ratio (-1)	0.564 (0.320)	0.526 (0.300)	0.507 (0.303)	0.264 (0.492)	0.224 (0.541)					
Real Interest Rate (-1)	0.094 (0.777)	0.073 (0.809)	0.078 (0.801)	-0.083 (0.492)						
Concentration	0.010 (0.801)	0.010 (0.797)	0.005 (0.881)							
Budget Balance (% of GDP) (-1)	-0.060 (0.806)	-0.055 (0.816)								
Current Account Balance (% of GDP) (-1)	0.062 (0.875)									

Note: the reported coefficients are the outcome of the logit estimator. Estimated period: 1980-2008. Coefficient (p-values).

C.2 The effects of bank concentration in out inteation model.

Dependent Variable: Crisis Onset	Regression Stage									
	1	2	3	4	5	6	7	8	9	10
Interest Rate Liberalization*Capital Adequacy Ratio (-1)	-0.963 (0.428)	-1.035 (0.187)	-1.106 (0.106)	-1.114 (0.107)	-1.136 (0.106)	-1.239 (0.078)	-1.230 (0.055)	-1.250 (0.057)	-1.292 (0.065)	-0.234 (0.004)
Liquidity Ratio (-1)	-0.198 (0.290)	-0.192 (0.085)	-0.200 (0.056)	-0.191 (0.057)	-0.178 (0.052)	-0.174 (0.053)	-0.190 (0.032)	-0.207 (0.016)	-0.184 (0.027)	-0.120 (0.036)
D Real House Price (-3)	0.151 (0.080)	0.150 (0.056)	0.153 (0.046)	0.143 (0.037)	0.130 (0.038)	0.144 (0.014)	0.151 (0.010)	0.160 (0.004)	0.152 (0.006)	0.134 (0.005)
Capital Adequacy Ratio (-1)	9.606 (0.403)	10.070 (0.185)	10.726 (0.110)	10.834 (0.111)	10.995 (0.112)	12.028 (0.084)	11.886 (0.060)	12.247 (0.058)	12.592 (0.067)	2.306 (0.011)
Constant	-37.382 (0.465)	-39.253 (0.272)	-42.047 (0.1929)	-42.213 (0.197)	-45.532 (0.167)	-49.650 (0.138)	-48.256 (0.110)	-48.953 (0.115)	-51.277 (0.123)	-2.058 (0.161)
Interest Rate Liberalization (-1)	3.255 (0.580)	3.729 (0.324)	4.136 (0.2156)	4.142 (0.220)	4.401 (0.198)	4.870 (0.156)	4.840 (0.121)	4.844 (0.130)	5.149 (0.132)	
ΔGDP (-1)	0.209 (0.348)	0.275 (0.237)	0.269 (0.239)	0.246 (0.246)	0.241 (0.251)	0.212 (0.268)	0.193 (0.285)	0.194 (0.296)		
Current Account Balance (% of GDP) (-1)	0.081 (0.828)	-0.213 (0.462)	-0.200 (0.468)	-0.196 (0.471)	-0.157 (0.563)	-0.214 (0.400)	-0.134 (0.560)			
M2 Money/ Forex Reserves (-1)	0.000 (0.555)	0.000 (0.577)	0.000 (0.584)	-0.000 (0.548)	-0.000 (0.467)	-0.000 (0.490)				
Inflation (-1)	0.297 (0.455)	0.285 (0.420)	0.267 (0.425)	0.237 (0.455)	0.159 (0.571)					
Real Interest Rate (-1)	0.054 (0.876)	-0.160 (0.576)	-0.165 (0.561)	-0.146 (0.599)						
Budget Balance (% of GDP) (-1)	0.006 (0.981)	-0.052 (0.751)	-0.046 (0.772)							
Δ Domestic Credit (-1)	0.000 (0.825)	-0.000 (0.823)								
Concentration	-0.000 (0.997)									

Note: the reported coefficients are the outcome of the logit estimator. Estimated period: 1980-2008. Coefficient (p-values).